CURRICULUM VITAE

MARC G. CARON, PH.D.

Date and Place of Birth:	July 26, 1946 L'Islet, Quebec, Canada
Marital Status:	Married
Citizenship:	US /Naturalized 08/08/2000)
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EDUCATION

B.Sc. (Biochemistry), Laval University, Quebec City, CANADA1969.
Ph.D. (Biochemistry), University of Miami, Miami, Florida 1973.

APPOINTMENTS

1969-1973	Graduate Teaching Assistant, Department of Biochemistry University of Miami, Miami, Florida
1973-1975	Research Associate, Departments of Medicine and Biochemistry Duke University Medical Center, Durham, North Carolina
1975-1977	Assistant Professor, Department of Physiology Laval University, Quebec, Canada
1977-1994	Assistant Medical Research Professor, Department of Medicine Duke University Medical Center, Durham, North Carolina
1978-1982	Assistant Medical Research Professor, Department of Biochemistry Duke University Medical Center, Durham, North Carolina
1981-1992	Senior Associate, Howard Hughes Medical Institute Duke University Medical Center, Durham, North Carolina
1983-1986	Assistant Professor, Department of Physiology Duke University Medical Center, Durham, North Carolina
1986-1989	Associate Professor, Dept. of Cell Biology (formerly Dept. of Physiology) Duke University Medical Center, Durham, North Carolina
1989-1998	Professor, Department of Cell Biology Duke University Medical Center, Durham, North Carolina
1992-present	Investigator, Howard Hughes Medical Institute Duke University Medical Center, Durham, North Carolina
1994-present	Research Professor, Department of Medicine Duke University Medical Center, Durham, North Carolina
1998-present	James B. Duke Professor of Cell Biology Duke Univresity Medical Center, Durham, North Carolina
2000-present	Interim Director, Center for Human Disease Models Institute for Genome Science and Policy, Duke University

HONORS AND AWARDS

1969-1973	Graduate Teaching Assistant, University of Miami, Miami, FL Doctoral Fellowship from la Direction Generale de l'Enseignement Superieur de la Province de Quebec
1973-1975	Postdoctoral Fellowship from Medical Research Council of Canada Postdoctoral Fellowship from la Direction Generale de l'Enseignement Superieur de la Province de Quebec
1975-1980	Scholar of the Medical Research Council of Canada (five year award) (relinquished in 1977)
February 1983	The 3rd John M. Marsh Memorial Lecturer, Univ. of Miami, Miami, FL
December 1986	Pfizer Lecturers Clinical Research Institute, Montreal, Canada
November 1988	Ariëns Lecture Award, Dutch Pharmacological Society, Utrecht, Holland
December 1988	"Presidential Lecture," ACNP 27th Annual Meeting, San Juan, Puerto Rico
September 1991	Javits Neuroscience Investigator Award (1991-1998)
April 1992	Grass Foundation Traveling Lectureship, University of Vermont
April 1993	Member of Jury of the 1993 Francqui Prize, Fondation Francqui, Brussels, Belgium
1994-1999	Awardee, Bristol-Myers Squibb Unrestricted Neuroscience Grant
1994-1999	Selection Committee, Bristol-Myers Squibb Distinguished Achievement in Neuroscience Research
April 1994	DuPont Prize for Receptor Research
April 1994	The Earl Sutherland Memorial Lecture, University of Miami, Miami, FL
May 1994	Merck Lecture, University of Sherbrooke, Sherbrooke, Quebec, Canada
1992-1994	Board of Directors, Laurentian Hormone Conference
May 1996	Carl F. Schmidt Honorary Lecture, University of Pennsylvania, Philadelphia, PA
April 1997	Eli Lilly Lecture, Department of Pharmacology, University of Montreal, Montreal, Quebec, Canada

HONORS AND AWARDS (cont'd.)

July 1997	Research Plenary Lecture, National Alliance for the Mentally Ill (NAMI), 17th Annual Convention, Albuquerque, NM
March 1998	University Lecturer, University of Texas Southwestern Medical Center Dallas, TX
April 1998	Distinguished Guest Lecture, Baylor College of Medicine, Houston, TX
April 1998	Distinguished Neuroscientist Seminar, Abbott Pharmaceuticals North Chicago, IL
May 1998	Distinguished Lecturer, Institute of Biomedical Sciences, Academia Sinica, Tapei, Taiwan
May 1998	The Charles W. Gowdey Distinguished Lecture Dept. of Pharmacology and Toxicology University of Western Ontario, London, ON, Canada
September 1998	Harold C. Hodge Lecture, Department of Pharmacology and Physiology University of Rochester, Rochester, New York
December 1998	Greenfield Lecture, Department of Pharmacology, Case Western University, Cleveland, OH
November 1999	Grass Lecture, Atlanta Chapter, Society for Neuroscience
September 2002	Nunez Lecture, XXVII European Symposium on "Hormones and Cell Reguation"

PROFESSIONAL SOCIETIES

American Physiological Society
Endocrine Society (U.S.)
International Society of Neuroendocrinology
Society for the Study of Reproduction
American Federation for Clinical Research
American Society for Pharmacology and Experimental Therapeutics
American Society for Biochemistry and Molecular Biology
Society for Neuroscience,

EDITORIAL BOARDS

Endocrinology (1982-1986)
Molecular Pharmacology (1983-1991)
Journal of Biological Chemistry (1987-1991)
Cellular Signaling (1989-1991)
Protein Science (1991-1992)
Endocrine Reviews (Editor) (1991-1995)
Biochemistry (Associate Editor) (1992-2001)
Endocrine Reviews (Editor-in-Chief) (1996-2001)

OTHER APPOINTMENTS

1998 - 2002	Board of Scientific Counselors for Intramural Research Program National Institute on Drug Abuse, NIH

PATENTS AWARDED

U.S. Patent No. 5,215,915.	Cloned gene encoding the rat D_{1B} dopamine receptor. June 1, 1993.
U.S. Patent No. 5,245,011.	Aqueous solution containing D_{1B} dopamine receptor. September 14, 1993.
Australian Patent No. 652576.	Expression of G protein coupled receptors in yeast. December 20, 1994.
U.S. Patent No. 5,389,543.	Cloned genes encoding the D_1 dopamine receptor. February 14, 1995.
U.S. Patent No. 5,418,162.	Serotonin transporter cDNA. May 23, 1995.
U.S. Patent No. 5, 482, 835.	Methods of testing in yeast cells for agonists and antagonists of mammal G protein coupled receptors. January 9, 1996.
U.S. Patent No. 5,547,845.	Aqueous solution containing D_1 dopamine receptor. August 20, 1996.
U.S. Patent No. 5,573,908.	Adrenergic receptor as a proto-oncogene. November 12, 1996.
U.S. Patent No. 5,580,775.	High affinity, brain-specific nucleic acids encoding a L-proline transporter, and vectors, and host cells comprising the same. December 3, 1996.
U.S. Patent No. 5,739,029	Vectors for expression of G protein coupled receptors in yeast. April 14, 1998.
U.S. Patent No. 5,866,756.	Dopamine transporter knockout mice. February 2, 1999

PUBLICATIONS

1. Caron, M.G. (1973) A study of the cholesterol side-chain cleavage enzyme in the bovine corpus luteum. Thesis, University of Miami.

2. Lefkowitz, R.J., Mukherjee, C., Coverstone, M. and Caron, M.G. (1974) Stereospecific [^{3}H](-)alprenolol binding sites: Beta-adrenergic receptors and adenylate cyclase. *Biochem. Biophys. Res. Commun.* **60**:703-709.

3. Caron, M.G. and Lefkowitz, R.J. (1974) Temperature immutability of adenyl cyclase-coupled beta-adrenergic receptors. *Nature* **249**:258-260.

4. Mukherjee, C., Caron, M.G. and Lefkowitz, R.J. (1975) Catecholamine-induced subsensitivity of adenylate cyclase associated with loss of beta-adrenergic receptors. *Proc. Natl. Acad. Sci. USA* **72**:1945-1949.

5. Caron, M.G., Goldstein, S., Savard, K. and Marsh, J.M. (1975) Protein kinase stimulation of a reconstituted cholesterol side-chain cleavage enzyme system in the bovine corpus luteum. *J. Biol. Chem.* **250**:5137-5143.

6. Mukherjee, C., Caron, M.G., Coverstone, M. and Lefkowitz, R.J. (1975) Identification of adenylate cyclase-coupled beta-adrenergic receptors in frog erythrocytes with (-)[^{3}H]alprenolol. *J. Biol. Chem.* **250**:4869-4876.

7. Lefkowitz, R.J. and Caron, M.G. (1975) Characteristics of 5'-guanylyl-imidodiphosphate activated adenylate cyclase. *J. Biol. Chem.* **250**:4418-4423.

8. Caron, M.G. and Lefkowitz, R.J. (1975) Beta-adrenergic receptors: Basic studies and clinical implications. In *New Directions in Asthma* (M. Stein, ed.). American College of Chest Physicians, Park Ridge, Ill., pp. 85-101.

9. Caron, M.G. and Lefkowitz, R.J. (1976) Beta-adrenergic receptors: Solubilization of (-)[^{3}H]alprenolol binding sites from frog erythrocyte membranes. *Biochem. Biophys. Res. Commun.* **68**:315-322.

10. Mukherjee, C., Caron, M.G., Mullikin, D. and Lefkowitz, R.J. (1976) Structure-activity relations of adenylate cyclase coupled beta-adrenergic receptors: Determination by direct binding studies. *Mol. Pharmacol.* **12**:16-31.

11. Lefkowitz, R.J., Caron, M.G., Limbird, L.E., Mukherjee, C. and Williams, L.T. (1976) Membrane-bound hormone receptors. In *Membrane-bound Enzymes* (A. Martinosi, ed.). Plenum Press, New York, pp. 283-310.

12. Lefkowitz, R.J., Mukherjee, C., Limbird, L.E., Caron, M.G., Williams, L.T., Alexander, R.W., Mickey, J.V. and Tate, R. (1976) Regulation of adenylate cyclase coupled beta-adrenergic receptors. In *Recent Progress in Hormone Research*, Vol. 32 (R.0. Greep, ed.). Academic Press, New York, pp. 597-632.

13. Lefkowitz, R.J., Caron, M.G., Mukherjee, C., Mickey, J.V. and Tate, R. (1976) Beta-adrenergic receptors: direct identification and physiological regulation. In *Cell Membrane Receptors for Viruses, Antigens and Antibodies, Polypeptide Hormones and Small Molecules* (R.F. Beers, Jr. and E.G. Bassett, eds.). Raven Press, New York, pp. 49-87.

14. Lefkowitz, R.J., Limbird, L.E., Mukherjee, C. and Caron, M.G. (1976) The beta-adrenergic receptor and adenylate cyclase. *Biochim. Biophys. Acta* **457**:1-39.

15. Mukherjee, C., Caron, M.G. and Lefkowitz, R.J. (1976) Regulation of beta-adrenergic receptor function by beta-adrenergic catecholamines *in vivo*. *Endocrinology* **99**:347-357.

16. Caron, M.G. and Lefkowitz, R.J. (1976) Biological activity of agarose immobilized catecholamines. *Biochim. Biophys. Acta* **444**:472-486.

17. Caron, M.G. and Lefkowitz, R.J. (1976) Solubilization and characterization of the beta-adrenergic receptor binding sites of frog erythrocytes. *J. Biol. Chem.* **251**:2374-2384.

18. Kelley, P.A., Asselin, J., Caron, M.G., Raynaud, J.P., Labrie, F. (1976) High inhibitory activity of a new antiestrogen, RU 16117 (11 alpha-methoxy-ethinyl estradiol) on the development of DMBA-induced mammary tumors. *Cancer Res.* **37**: 76-81.

19. Lefkowitz, R.J., Mullikin, D. and Caron, M.G. (1976) Regulation of beta-adrenergic receptors by guanyl-5'-yl-imidodiphosphate and other purine nucleotides. *J. Biol. Chem.* **251**:4686-4692.

20. Lefkowitz, R.J., Mukherjee, C., Caron, M.G., Mickey, J.V. and Tate, R. (1976) Biochemical mechanisms for regulation of beta-adrenergic receptors by beta-adrenergic agonists. *Excerpta Medica Int. Cong. Series* **402**:502-506.

21. Morin, O., Caron, M.G., De Lean, A. and Labrie, F. (1976) Binding of the opiate-like pentapeptide methionine-enkephalin to membranes from rat brain. *Biochem. Biophys. Res. Commun.* **73**:940-946.

22. Coy, D.H., Kastin, A.J., Schally, A.V., Morin, O., Caron, M.G., Labrie, F., Walker, J.M., Fertel, R., Berntson, G.G. and Sandman, C.A. (1976) Synthesis and opioid activities of stereoisomers and other D-amino acids analogs of methionine-enkephalin. *Biochem. Biophys. Res. Commun.* **73**:632-638.

23. Caron, M.G., Mukherjee, C., and Lefkowitz, R.J. (1977) Beta-adrenergic receptors: Structure activity relations determined by direct binding studies. In *Receptors in Pharmacology* (G. Smythies and R.J. Bradley, eds.). Marcel Dekker, Inc., New York, pp. 97-121.

24. Kelly, P.A., Asselin, J., Caron, M.G., Labrie, F. and Raynaud, J.P. (1977) Potent inhibitory effect of a new antiestrogen (RU 16117) on the growth of DMBA-induced mammary tumors. *J. Natl. Cancer Inst.* **58**:623-628.

25. Caron, M.G., Gagne, B. and De Lean, A. (1977) Identification of beta-adrenergic receptors in rat hypothalamus. *Can. J. Biochem.* **55**:693-699.

26. Asselin, J.A., Kelly, P.A., Caron, M.G. and Labrie, F. (1977) Control of hormone receptor levels and growth of 7,12-dimethylbenz(a) anthracene-induced mammary tumors by estrogens, progesterone and prolactin. *Endocrinology* **101**:666-671.

27. Labrie, F., Borgeat, P., Drouin, J., Lagace, L., Beaulieu, M., De Lean, A., Dupont, A., Lemay, A., Belanger, A., Caron, M.G., Kelly, P.A. and Cusan, L. (1977) Mecanisme d'action des hormones hypothalamiques dans l'adenohypophyse et modulation de leur activite. In *Les Hvpothalamiques Comptes-Rendus du 41eme Congress Francais de Medecine*, Masson, pp. 37-58.

28. Marsh, J.M., Ling, W.Y., Williams, M.T., Goldstein, S., Caron, M.G. and Lemaire, W.J. (1978) Mechanism of action of lutropin in the corpus luteum. International *Symposium on the Endocrinology of the Ovary*, Editions SEPE, Paris, France, p. 131.

29. Bukowiecki, L.J., Caron, M.G., Valieres, J. and LeBlanc, J. (1978) Beta-adrenergic receptors in brown adipose tissue: Identification by (-)[^{3}H]dihydroalprenolol binding. In *Effectors of Thermogenesis*. (L. Girardier and J. Seydoux, eds.). *Except Medica Suppl.* **32**:55-59.

30. Williams, M.T., Clark, M.R., Ling, W.V., LeMaire, W.J., Caron, M.G. and Marsh, J.M. (1978) Role of cyclic AMP in the actions of luteinizing hormone on steroidogenesis in the corpus luteum. *Adv. Cyclic Nucleotide Res.*, Vol. 9 (W.J. George and L.J. Ignarro, eds.). Raven Press, New York, pp. 573-582.

31. Caron, M.G., Beaulieu, M., Raymond, V., Gagne, B., Drouin, J., Lefkowitz, R.J. and Labrie, F. (1978) Dopaminergic receptor in the anterior pituitary gland: correlation of [3H]dihydroergocryptine binding with the dopaminergic control of prolactin release. *J. Biol. Chem.* **253**: 2244-2253.

32. Caron, M.G., Williams, L.T. and Lefkowitz, R.J. (1978) The labeling of adrenoceptors in peripheral tissues. In *Recent Advances in the Pharmacology of Adrenoceptors* (E. Szabadi, C.M. Bradshaw, and P. Bevan eds.). Elsevier/North-Holland Biomedical Press, Amsterdam, pp. 134-144.

33. Labrie, F., Drouin, J., Ferland, L., Lagace, L., Beaulieu, M., De Lean, A., Kelly, P.A., Caron, M.G., and Raymond, V. (1978) Mechanism of action of hypothalamic hormones in the anterior pituitary gland and specific modulation of their activity by sex steroids and thyroid hormones. *Recent Progress in Hormone Research.* **34**:25-93.

34. Pitha, J., Kociolek, K. and Caron, M.G. (1979) Detergents linked to polysaccharides: Preparation and effects on membranes and cells. *Eur. Jour. Biochem.* **94**:18-24.

35. Caron, M.G., Srinivasan, Y., Pitha, J. and Lefkowitz, R.J. (1979) The beta-adrenergic receptor of frog erythrocyte: Purification by biospecific affinity chromatography. In *Catecholamines: Basic and Clinical Frontiers* (E. Usdin, I.J. Kopin and J. Barthas, eds.). Pergamon Press, New York, pp. 547-549.

36. Caron, M.G., Srinivasan, Y., Pitha, J., Kociolek, K. and Lefkowitz, R.J. (1979) Affinity chromatography of the beta-adrenergic receptor. *J. Biol. Chem.* **254**:2923-2927.

37. Wood, C.L., Caron, M.G. and Lefkowitz, R.J. (1979) Separation of solubilized alpha and beta-adrenergic receptors by affinity chromatography. *Biochem. Biophys. Res. Commun.* **88**:1-8.

38. Caron, M.G., Srinivasan, Y., Snyderman, R. and Lefkowitz, R.J. (1979) Antibodies raised against purified beta-adrenergic receptors specifically bind beta-adrenergic ligands. *Proc. Natl. Acad. Sci. USA* **76**: 2263-2267.

39. Caron, M.G., Limbird, L.E. and Lefkowitz, R.J. (1979) Biochemical characterization of the beta-adrenergic receptor of the frog erythrocyte. *Mol. Cell. Biochem.* **28**: 45-67.

40. Labrie, F., Beaulieu, M., Caron, M.G. and Raymond, V. (1979) The adenohypophyseal dopamine receptor: specificity and modulation of its activity by estradiol. In *Progress in Prolactin Physiology and Pathology* (C. Robyn and M. Harter, eds.). Elsevier/North Holland, Amsterdam, pp. 121-136.

41. Caron, M.G., Srinivasan, Y. and Lefkowitz, R.J. (1980) Affinity chromatography of the beta-adrenergic receptor and characterization of antibodies raised against purified receptor preparations. In *Receptors for Neurotransmitters and Peptide Hormones* (G. Pepeu M.J. Kuhar and S. Enna, eds.). *Adv. Biochem. Psychopharmacol.* **21**:151-158.

42. Schocken, D.D., Caron, M.G. and Lefkowitz, R.J. (1980) The human placenta-an unusually rich source of beta-adrenergic receptor: characterization of the receptor in particulate and solubilized preparations. *J. Endo. Met.* **50**: 1082-1088.

43. Pitha, J., Zjawiony, J., Lefkowitz, R.J. and Caron, M.G. (1980) Macromolecular beta-adrenergic antagonists discriminating between receptor and antibody. *Proc. Natl. Acad. Sci. USA* **77**: 2219-2223.

44. Pitha, J., Zjawiony, J., Nasrin, N., Lefkowitz, R.J. and Caron, M. G. (1980) Potent beta-adrenergic antagonist possessing chemically reactive group. *Life Sci.* **27**: 1791-1798.

45. Pitha, J., Zjawiony, J., Lefkowitz, R.J. and Caron, M.G. (1981) Polymeric drugs by direct copolymerization: Polymer of beta-adrenergic antagonist alprenolol and its binding to receptors and antibodies. *Makromol. Chem.* **182**: 1945-1950.

46. Shorr, R.G.L., Lefkowitz, R.J. and Caron, M.G. (1981) Purification of the beta-adrenergic receptor: Identification of the hormone binding site. *J. Biol. Chem.* **256**: 5820-5826.

47. Caron, M.G., Shorr, R.G.L., Lefkowitz, R.J., Heald, S.L., Jeffs, P.W., Zjawiony, J. and Pitha, J. (1981) Isolation and characterization of the beta-adrenergic receptor of frog erythrocytes and development of potential affinity ligands. *Adv. Cyclic Nucleotide Res.* **14**: 127-134.

48. Michel, T., Hoffman, B.B., Lefkowitz, R.J. and Caron, M.G. (1981) Different sedimentation properties of agonist- and antagonist-labeled platelet alpha2 adrenergic receptors. *Biochem. Biophys. Res. Commun.* **100**: 1131-1136.

49. Lavin, T.N., Heald, S.L., Jeffs, P.W., Shorr, R.G.L., Lefkowitz, R.J. and Caron, M.G. (1981) Photoaffinity labeling of the beta-adrenergic receptor. *J. Biol. Chem.* **256**: 11944-11950.

50. Lefkowitz, R.J., Caron, M.G. and Stadel, J.M. (1982) Mechanisms of hormone receptor-effector coupling: the beta-adrenergic receptor and adenylate cyclase. *Fed. Proc.* **41**: 2664-2670.

51. De Lean, A., Kilpatrick, B.F. and Caron, M.G. (1982) Guanine nucleotides regulate both dopaminergic agonist and antagonist binding in porcine anterior pituitary. *Endocrinology* **110**: 1064-1066.

52. Shorr, R.G.L., Heald, S.L., Jeffs, P.W., Lavin, T.N., Strohsacker, M.W., Lefkowitz, R.J. and Caron, M.G. (1982) The beta-adrenergic receptor: Rapid purification and covalent labeling by photoaffinity cross-linking. *Proc. Natl. Acad. Sci. USA* **79**: 2778-2782.

53. Caron, M.G., Shorr, R.G.L., Lavin, T.N. and Lefkowitz, R.J. (1982) Molecular characterization of the beta-adrenergic receptor of frog erythrocytes. *Metabolism* **31**: 658-663.

54. Shorr, R.G.L., Strohsacker, M.W., Lavin, T.N., Lefkowitz, R.J. and Caron, M.G. (1982) The beta-adrenergic receptor of the turkey erythrocyte: Molecular heterogeneity revealed by purification and photoaffinity labeling. *J. Biol. Chem.* **257**: 12341-12350.

55. Lavin, T.N., Nambi, P., Heald, S.L., Jeffs, P.W., Lefkowitz, R.J. and Caron, M.G. (1982) [125I]p-Azidobenzylcarazolol, a photoaffinity label for the beta-adrenergic receptor: Characterization of the ligand and photoaffinity labeling of beta1 and beta2 adrenergic receptors. *J. Biol. Chem.* **257**:12332-12340.

56. De Lean, A., Kilpatrick, B.F. and Caron, M.G. (1982) Dopamine receptor of the porcine anterior pituitary gland: Evidence for two affinity states discriminated by both agonists and antagonists. *Mol. Pharmacol.* **22**: 290-297.

57. Kilpatrick, B.F., De Lean, A. and Caron, M.G. (1982) Dopamine receptor of the porcine anterior pituitary gland: Effects of N-ethylmaleimide and heat on ligand binding mimic the effects of guanine nucleotides. *Mol. Pharmacol.* **22**: 298-303.

58. Stadel, J.M., Nambi, P., Lavin, T.N., Heald, S.L., Caron, M.G. and Lefkowitz, R.J. (1982) Catecholamine-induced desensitization of turkey erythrocyte adenylate cyclase: Structural alterations in the beta-adrenergic receptor revealed by photoaffinity labeling. *J. Biol. Chem.* **257**: 9242-9245.

59. Regan, J.W., Barden, N., Lefkowitz, R.J., Caron, M.G., DeMarinis, R.M., Krog, A.J., Holden, K.G., Matthews, W.D. and Hieble, J.P. (1982) Affinity chromatography of human platelet alpha2-adrenergic receptors. *Proc. Natl. Acad. Sci. USA* **79**:7223-7227.

60. Lefkowitz, R.J., Caron, M.G., Michel, T. and Stadel, J.M. (1982) Mechanisms of hormone receptor-effector coupling: The beta-adrenergic receptor and adenylate cyclase. *Fed. Proc.* **41**: 2664-2670.

61. Caron, M.G., Lavin, T., Shorr, R.G. and Lefkowitz, R.J. (1982) Purification and photoaffinity labeling of the beta-adrenergic receptor of frog erythrocyrtes. *Metabolism* **31**: 658-663.

62. Stiles, G.L., Hoffman, B.B., Hubbard, M., Caron, M.G. and Lefkowitz, R.J. (1983) Guanine nucleotides and alpha1 adrenergic receptors in the heart. *Biochem. Pharmacol.* **32**: 69-71.

63. Heald, S.L., Jeffs, P.W., Lavin, T.N., Nambi, P., Lefkowitz, R.J. and Caron, M.G. (1983) Synthesis of a potent beta-adrenergic photoaffinity probe: Radioiodinated 15-[4'-azidobenzyl]carazolol. *J. Med. Chem.* **26**: 832-838.

64. Stadel, J.M., Strulovici, B., Nambi, P., Lavin, T.N., Briggs, M.M., Caron, M.G. and Lefkowitz, R.J. (1983) Desensitization of the beta-adrenergic receptor of frog erythrocytes: Recovery and characterization of the down regulated receptors in sequestered vesicles. *J. Biol. Chem.* **258**: 3032-3038.

65. Benovic, J.L., Stiles, G.L., Lefkowitz, R.J. and Caron, M.G. (1983) Photoaffinity labeling of mammalian beta-adrenergic receptors: Metal-dependent proteolysis explains apparent heterogeneity. *Biochem. Biophys. Res. Commun.* **110**:504-511.

66. Lefkowitz, R.J., Stadel, J.M. and Caron, M.G. (1983) Adenylate cyclase-coupled beta-adrenergic receptors: Structure and mechanisms of activation and desensitization. *Annu. Rev. Biochem.* **52**: 159-186.

67. Strader, C.D., Pickel, V.M., Joh, T.H., Strohsacker, M.W., Shorr, R.G.L., Lefkowitz, R.J. and Caron, M.G. (1983) Antibodies to the beta-adrenergic receptor: Attenuation of catecholamine-sensitive adenylate cyclase and demonstration of postsynaptic receptor localization in brain. *Proc. Natl. Acad. Sci. USA* **80**: 1840-1844.

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77. Wikberg, J.E.S., Akers, M., Caron, M.G. and Hagen, P.-O. (1983) Norepinephrine-induced down regulation of α-adrenergic receptors in cultured rabbit aorta smooth muscle cells. *Life Sci.* **33**: 1409-1418.

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